

This listing of claims will replace all prior versions and listings of the claims in the application:

Listing of the Claims:

- 1-5. (Canceled)
6. (Currently amended) An ~~instrument~~ apparatus for the measurement of isotopes at extremely low concentration and isotopes of very low abundance comprising an Inductively Coupled Plasma Source Mass Spectrometer equipped with a multi-dimensional detector system wherein ions transmitted by the mass spectrometer are detected with high selectivity.
7. (Currently amended) An ~~instrument~~ apparatus according to claim 6 wherein the multi-dimensional detector system comprises a plurality of sub-systems which provide a unitary response.
8. (Currently amended) An ~~instrument~~ apparatus according to claim 7 wherein the multi-dimensional detector system comprises two sub-systems.
9. (Currently amended) An ~~instrument~~ apparatus according to claim 7 wherein the sub-systems comprise a specific detector and a non-specific detector.
10. (Currently amended) An ~~instrument~~ apparatus according to claim 8 wherein the two sub-systems of the multidimensional detector system are correlated temporally with high resolution.
11. (Currently amended) An ~~instrument~~ apparatus according to claim 10 that provides co-incidence detection of transmitted ions.

12. (Currently amended) An ~~instrument~~ apparatus according to claim 9 wherein the specific detector is based on optical spectrometry.

13. (Currently amended) An ~~instrument~~ apparatus according to claim 12 wherein the specific detection of the transmitted ions is *via* resonance scattering processes.

14. (Currently amended) An ~~instrument~~ apparatus according to claim 13 wherein the specific detection of the transmitted ions is *via* laser induced fluorescence.

15. (Currently amended) An ~~instrument~~ apparatus according to claim 13 provided with means for collecting and detecting resonantly scattered photons efficiently.

16. (Currently amended) An ~~instrument~~ apparatus according to claim 13 provided with means for the detection of the resonantly scattered photons with high temporal and spatial resolution.

17. (Currently amended) An ~~instrument~~ apparatus according to claim 16 wherein the detection of resonantly scattered photons is *via* an imaging photomultiplier tube.

18. (Currently amended) An ~~instrument~~ apparatus according to claim 9 wherein the second detector is a nonspecific ion counting device.

19. (Currently amended) An ~~instrument~~ apparatus according to claim 18 wherein the nonspecific ion counting device is an electron multiplier.

20. (Currently amended) An ~~instrument~~ apparatus according to claim 6 provided with means for manipulating the mean ion energy thereby reducing the relative spread of the ion beams energies.

21. (Currently amended) An ~~instrument~~ apparatus according to claim 20 wherein the relative spread of ion beam energies may be manipulated to compress the optical bandwidth of the transmitted ions.

22. (Currently amended) An ~~instrument~~ apparatus according to claim 20 provided with means for accelerating or decelerating the transmitted ion beam to manipulate the average ion beam energy and consequently the relative spread of ion beam energies.

23. (Currently amended) An ~~instrument~~ apparatus according to claim 6 wherein a front-end collision/reaction cell is used to reduce the spread of the ion beam energies and compress the optical bandwidth of the transmitted ions.

24. (Currently amended) An ~~instrument~~ apparatus according to claim 6 provided with means for manipulating the ion beam energies to bring the transmitted ion beam into resonance within the detection volume of the optical detector.

25. (Currently amended) An ~~instrument~~ apparatus according to claim 24 provided with means for accelerating or decelerating the ion beam.

26. (Currently amended) An ~~instrument~~ apparatus according to claim 12 wherein the ion beam is accelerated to induce an optical isotope shift by Doppler shifting.

27. (Currently amended) An ~~instrument~~ apparatus according to claim 6 wherein a multiple exit slit assembly is incorporated.

28. (Currently amended) An ~~instrument~~ apparatus according to claim 27 wherein the dual detector assembly is mounted upon the multiple slit assembly.

29. (Currently amended) An ~~instrument~~ apparatus according to claim 28 wherein the dual detector assembly is mounted upon the axial exit slit.

30. (Currently amended) An ~~instrument~~ apparatus according to claim 27 wherein additional nonspecific ion detectors are mounted upon the multiple exit slit assembly.

31. (Currently amended) An ~~instrument~~ apparatus according to claim 30 wherein additional nonspecific ion detectors are mounted upon the off-axis exit slits.

32. (Currently amended) An ~~instrument~~ apparatus according to claim 31 wherein the nonspecific ion detectors are electron multiplier devices.

33. (Currently amended) A method for detecting and quantifying low concentrations of stable and/or radioisotopes and/or low abundance isotopes which comprises analyzing a sample in an ~~instrument~~ apparatus according to claim 6.

34. (Original) A method according to claim 33 wherein the species being detected is a radionuclide.

35. (Original) A method according to claim 33 wherein selectivity is enhanced by specific optical detection of transmitted ions.

36. (Original) A method according to claim 33 wherein selectivity is enhanced by specific isotopic selection via optical isotope shifts.

37. (Original) A method according to claim 33 wherein selectivity is enhanced by inducing an optical isotope shift by acceleration of the transmitted ions with subsequent Doppler shifting.

38. (Original) A method according to claim 33 wherein selectivity is enhanced by optical probing of hyperfine splitting.

39. (Original) A method according to claim 33 wherein nonspecific background is reduced by co-incidence detection of transmitted ions with subsequent improved detection limit.

40. (New) An apparatus according to claim 6, wherein the multi-dimensional detector system comprises a multi-slit assembly, wherein the mass spectrometer is coupled to the multi-slit assembly and wherein the mass spectrometer is a coincidence laser spectrometer comprising:

an optical detector coupled to the multi-slit assembly for specific detection of transmitted ions;

a voltage programmer flight tube coupled to the optical detector, the voltage programmer flight tube including a non-specific ion detector configured for the non-specific counting of transmitted ions, the flight tube further including an exit port at a first end thereof and a laser system at a second end thereof; and

a charged beam steering optics assembly positioned proximate the exit port of the flight tube.

41. (New) The apparatus of claim 40, wherein the non-specific ion detector comprises an electron multiplier.

42. (New) The apparatus of claim 40, further comprising a second non-specific ion detector mounted on the multi-slit assembly.

43. (New) The apparatus of claim 40, wherein the optical detector is configured to detect transmitted ions by resonance scattering.

44. (New) The apparatus of claim 40, wherein the optical detector is configured to detect transmitted ions by laser induced fluorescence.

45. (New) An apparatus as claimed in claim 6 for the ultra low level determination of radionuclides.

46. (New) An apparatus as claimed in claim 6 said apparatus comprising an optical spectrometer.

47. (New) An apparatus as claimed in claim 6 said apparatus comprising a non-specific ion detection device.

48. (New) An apparatus as claimed in claim 46 wherein said optical spectrometer is adapted to provide highly selective and specific detection of ions transmitted by the mass spectrometer.

49. (New) An apparatus as claimed in claim 48 wherein said optical spectrometer provides a high resolution detection system, which in conjunction with conventional mass spectrometry, is capable of resolving ions of interest from interfering molecular ions of similar nominal mass to charge ratio.

50. (New) An apparatus as claimed in claim 48 wherein said optical spectrometer provides a high resolution spectroscopy system, which in conjunction with conventional mass spectrometry, is capable of resolving ions of interest from atomic ions of similar nominal mass to charge ratio.

51. (New) An apparatus as claimed in claim 48 wherein said optical spectrometer provides a high resolution spectroscopy system, which in conjunction with conventional mass spectrometry, provides very high abundance sensitivity.

52. (New) An apparatus as claimed in claim 6 which comprises an Inductively Coupled Plasma Mass Spectrometry Coincidence Laser Spectrometer.

53. (New) An apparatus as claimed in claim 6, said apparatus comprising a laser induced fluorescence spectrometer.

54. (New) An apparatus as claimed in claim 46 wherein said optical spectrometer operates in time correlation with a second detector.

55. (New) An apparatus as claimed in claim 6 which comprises an imaging spectrometer.

56. (New) An apparatus as claimed in claim 55 wherein said imaging spectrometer comprises a sector mass spectrometer.

57. (New) An apparatus as claimed in claim 56 wherein said sector mass spectrometer comprises a double focusing sector Inductively Coupled Plasma Mass Spectrometer.

58. (New) An apparatus as claimed in claim 57 which comprises a collision/reaction cell to act as an ion bridge between a sampler/skimmer plasma interface and the mass spectrometer.

59. (New) An apparatus as claimed in claim 57 which comprises means for effecting acceleration of ions to compress the optical bandwidth of the ions to be detected.

60. (New) An apparatus as claimed in claim 6, adapted such that the abundance sensitivity of the spectrometer is improved.

61. (New) An apparatus as claimed in claim 60 wherein an ion of interest is brought into resonance selectively.

62. (New) An apparatus as claimed in claim 60 wherein the selectivity of the mass spectrometer is increased by selective excitation of one hyperfine branch of an ion of interest.

63. (New) An apparatus as claimed in claim 60 wherein acceleration of the ions induces an isotope shift by Doppler shifting the resonant frequency of the low abundant ion away from the interfering major isotope.

64. (New) An apparatus as claimed in claim 6 which comprises two-colour excitation schemes wherein the metastable state is in resonance with one of the laser frequencies.

65. (New) An apparatus as claimed in claim 6 which comprises a multi-slit assembly.

66. (New) A method for the measurement of isotopes at extremely low concentrations and isotopes of very low abundance which comprises analysing a sample in an apparatus as claimed in claim 6.

67. (New) A method as claimed in claim 66 for the ultra low level determination of radionuclides.

68. (New) A method as claimed in claim 66, wherein said apparatus comprises an optical spectrometer.

69. (New) A method as claimed in claim 67, wherein said apparatus comprises a non-specific ion detection device.

70. (New) A method as claimed in claim 68 wherein said optical spectrometer is adapted to provide highly selective and specific detection of ions transmitted by the mass spectrometer.

71. (New) A method as claimed in claim 70 wherein said optical spectrometer provides a high resolution detection system, which in conjunction with conventional mass spectrometry, is capable of resolving ions of interest from interfering molecular ions of similar nominal mass to charge ratio.

72. (New) A method as claimed in claim 70 wherein said optical spectrometer provides a high resolution spectroscopy system, which in conjunction with conventional mass spectrometry, is capable of resolving ions of interest from atomic ions of similar nominal mass to charge ratio.

73. (New) A method as claimed in claim 70 wherein said optical spectrometer provides a high resolution spectroscopy system, which in conjunction with conventional mass spectrometry, provides very high abundance sensitivity.

74. (New) A method as claimed in claim 66 which comprises analysing a sample in an Inductively Coupled Plasma Mass Spectrometry Coincidence Laser Spectrometer.

75. (New) A method as claimed in claim 66, wherein said apparatus comprises a laser induced fluorescence spectrometer.

76. (New) A method as claimed in claim 68 wherein said optical spectrometer operates in time correlation with a second detector.

77. (New) A method as claimed in claim 66, wherein said apparatus comprises an imaging spectrometer.

78. (New) A method as claimed in claim 77 wherein said imaging spectrometer comprises a sector mass spectrometer.

79. (New) A method as claimed in claim 78 wherein said sector mass spectrometer comprises a double focusing sector Inductively Coupled Plasma Mass Spectrometer.

80. (New) A method as claimed in claim 79 wherein said apparatus comprises a collision/reaction cell to act as an ion bridge between a sampler/skimmer plasma interface and the mass spectrometer.

81. (New) A method as claimed in claim 79 wherein said apparatus comprises means for effecting acceleration of ions to compress the optical bandwidth of the ions to be detected.

82. (New) A method as claimed in claim 66, wherein said apparatus is adapted such that the abundance sensitivity of the spectrometer is improved.

83. (New) A method as claimed in claim 82 wherein an ion of interest is brought into resonance selectively.

84. (New) A method as claimed in claim 82 wherein the selectivity of the mass spectrometer is increased by selective excitation of one hyperfine branch of an ion of interest.

85. (New) A method as claimed in claim 82 wherein acceleration of the ions induces an isotope shift by Doppler shifting the resonant frequency of the low abundant ion away from the interfering major isotope.

86. (New) A method as claimed in claim 66 wherein said apparatus comprises two-colour excitation schemes wherein the metastable state is in resonance with one of the laser frequencies.

87. (New) A method as claimed in claim 66 wherein said apparatus comprises a multi-slit assembly.